

# POWER TO THE PEOPLE

## Integrating Wind in Villages

By Meera Kohler

Native Village Energy Workshop

Anchorage, Alaska

October 17, 2012

# AVEC is a non-profit member-owned cooperative

- 55 villages
- Formed in 1968
- 7 member Board
- 23,000 Population
- Anvik - 86
- Hooper Bay – 1,124



# SYSTEM INFORMATION

- 80 Anchorage-based Employees
- 7,800 services
- 50 power plants

- 165 + diesel generators
- 95 Village technicians
- 530 + fuel tanks
- Over 5 million gallons fuel burned
- 11 wind systems serving 15 villages
  - 34 turbines total



# Alaska Vs. Lower Forty Eight





# AVEC's DELIVERED FUEL COST

• Average 2002	1.29
• Average 2003	1.47
• Average 2004	1.98
• Average 2005	2.26
• Average 2006	2.26
• Average 2007	2.93
• Average 2008	4.55
• Average 2009	3.02
• Average 2010	3.30
• Average 2011	4.27
• Average 2012	4.02

**Increase 2002 – 2012    \$2.73    +312%**

# AVEC BOARD 2018 GOALS

- Lower diesel use **25%**
  - 1,250,000 gallons
  - 77% of our fuel is used in Wind Class 4+ villages
- Reduce power plants **by 50%**
  - Interconnect another 24 villages
  - Wind is 6% of generation capacity
  - 5% of 2011 generation
- Reduce non-fuel costs **by 10%**
  - Plant costs, depreciation, interest...
  - **Reduced rates 2 cents/kWh**



# What is AVEC Doing?

## Installing wind generation

- Selawik, Toksook Bay, Kasigluk, Gambell, Savoonga, Hooper Bay, New Stuyahok, Emmonak, Quinhagak, Chevak, Mekoryuk, Shaktoolik...

## Capturing recovered heat where feasible

- More than 40 AVEC locations

## Building Interties

- Toksook Bay to Tununak
- Toksook Bay to Nightmute
- Brevig Mission to Teller
- Developing HVDC concept

## Welcoming new villages

- Nightmute (1998), Teller (2005), Kotlik (2007), Ekwook (2011) Kobuk (2012)

# Interconnecting Villages

Reduce the number of power plants

Larger loads make renewables like wind feasible

## Existing Interties

- Kasigluk-Nunapitchuk
- St. Mary's-Andreafsky
- Upper Kalskag-Lower Kalskag
- St. Mary's-Pitka's Point
- Shungnak-Kobuk
- Toksook Bay-Tununak
- Toksook Bay-Nightmute
- Emmonak - Alakanuk



# Future Interties

- **St. Michael's-Stebbins - Underway**
- **Brevig Mission-Teller - Underway**
- **St. Mary's-Mt. Village**
- **St. Mary's-Pilot Station**
- **New Stuyahok-Ekwok**
- **Togiak-Twin Hills**
- **Noorvik – Kiana – Selawik (NKS)**
- **Ambler – Shungnak – Kobuk (ASK)**
- **Upper Kobuk – Lower Kobuk (ASK – NKS)**

# AVEC Wind Projects

- 2003 Selawik
- 2006 Kasigluk – with a tie line to Nunapitchuk
- 2006 Toksook Bay - with tie lines to Tununak and Nightmute
- 2008 Hooper Bay and Savoonga
- 2009 Gambell
- 2009 Mekoryuk and Chevak erected, commissioned in 2010
- 2010 Quinhagak
- 2010 Toksook - one more turbine
- 2011 Emmonak/Alakanuk and Shaktoolik



*Kasigluk*

# Benefits of Integrating Wind Generation

- A hedge against rising fuel costs
- Lower carbon footprint
- Reduced exposure to oil spills
- Reduced oil storage needs





The State and federal governments funded over 100 wind projects in Alaska in the 1980s





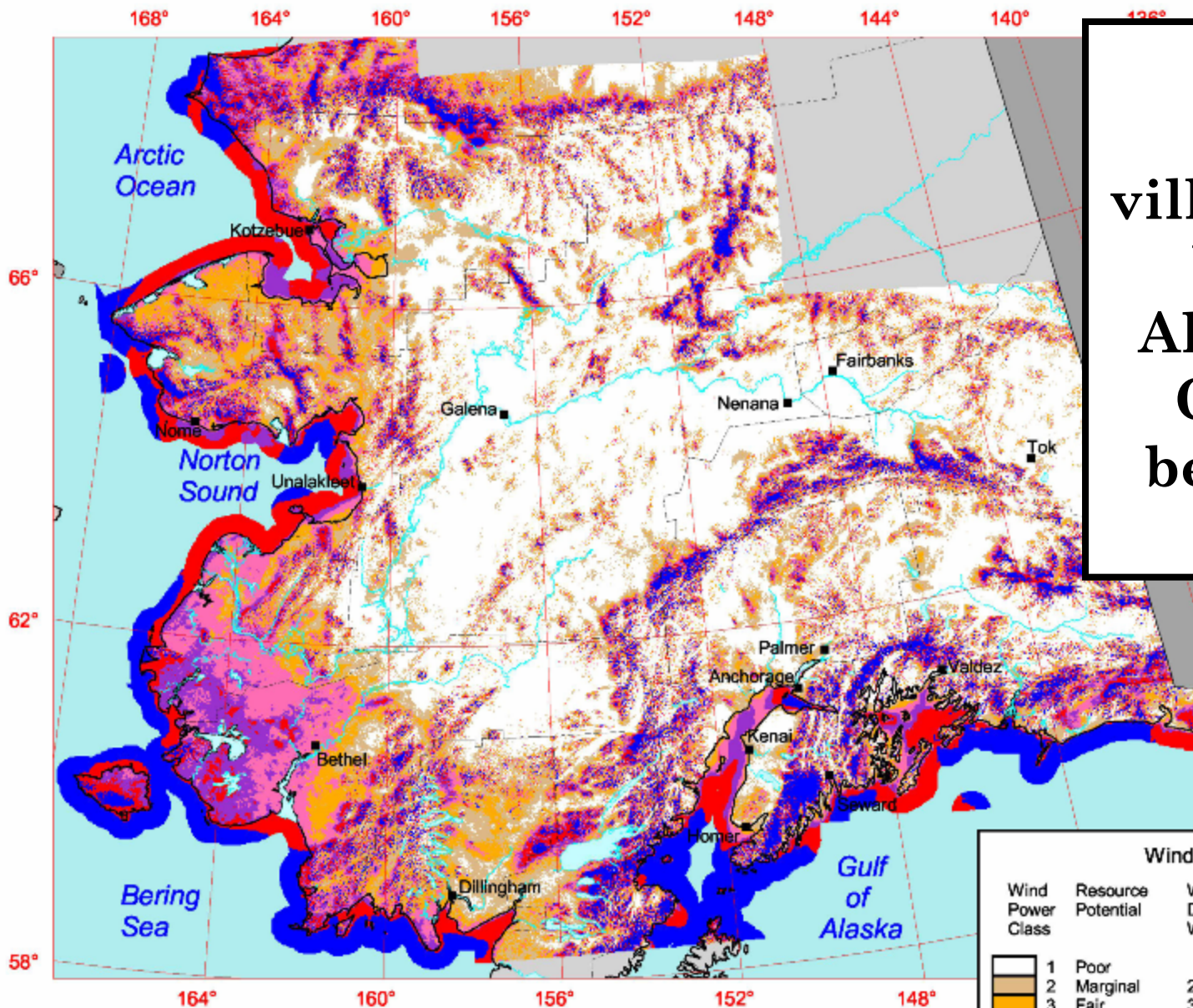
Nearly all failed. Lack of maintenance and poor sites were factors.



# Harnessing the Wind

- 34 of AVEC's 55 villages are in class 4+ wind regimes
- A high-efficiency diesel generator yields 14 kWh/gallon
- A 100-kW turbine could produce 220,000 kWh/yr = 16,000 gallons displaced
- Four units (a wind plot) = 64,000 gallons displaced





Many of  
AVEC's  
villages are in  
Western  
Alaska have  
Class 4 or  
better wind  
regimes.

The annual wind power estimates for this map were produced by AWS Truewind using their Mesomap system and historical weather data. It has been validated with available surface data by NREL and wind energy meteorological consultants.

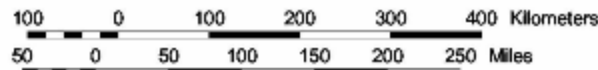
#### Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m <sup>2</sup>	Wind Speed <sup>a</sup> at 50 m m/s	Wind Speed <sup>a</sup> at 50 m mph
1	Poor	0 - 200	0.0 - 5.3	0.0 - 11.9
2	Marginal	200 - 300	5.3 - 6.1	11.9 - 13.7
3	Fair	300 - 400	6.1 - 6.7	13.7 - 15.0
4	Good	400 - 500	6.7 - 7.3	15.0 - 16.4
5	Excellent	500 - 600	7.3 - 7.7	16.4 - 17.2
6	Outstanding	600 - 800	7.7 - 8.5	17.2 - 19.0
7	Superb	> 800	> 8.5	> 19.0

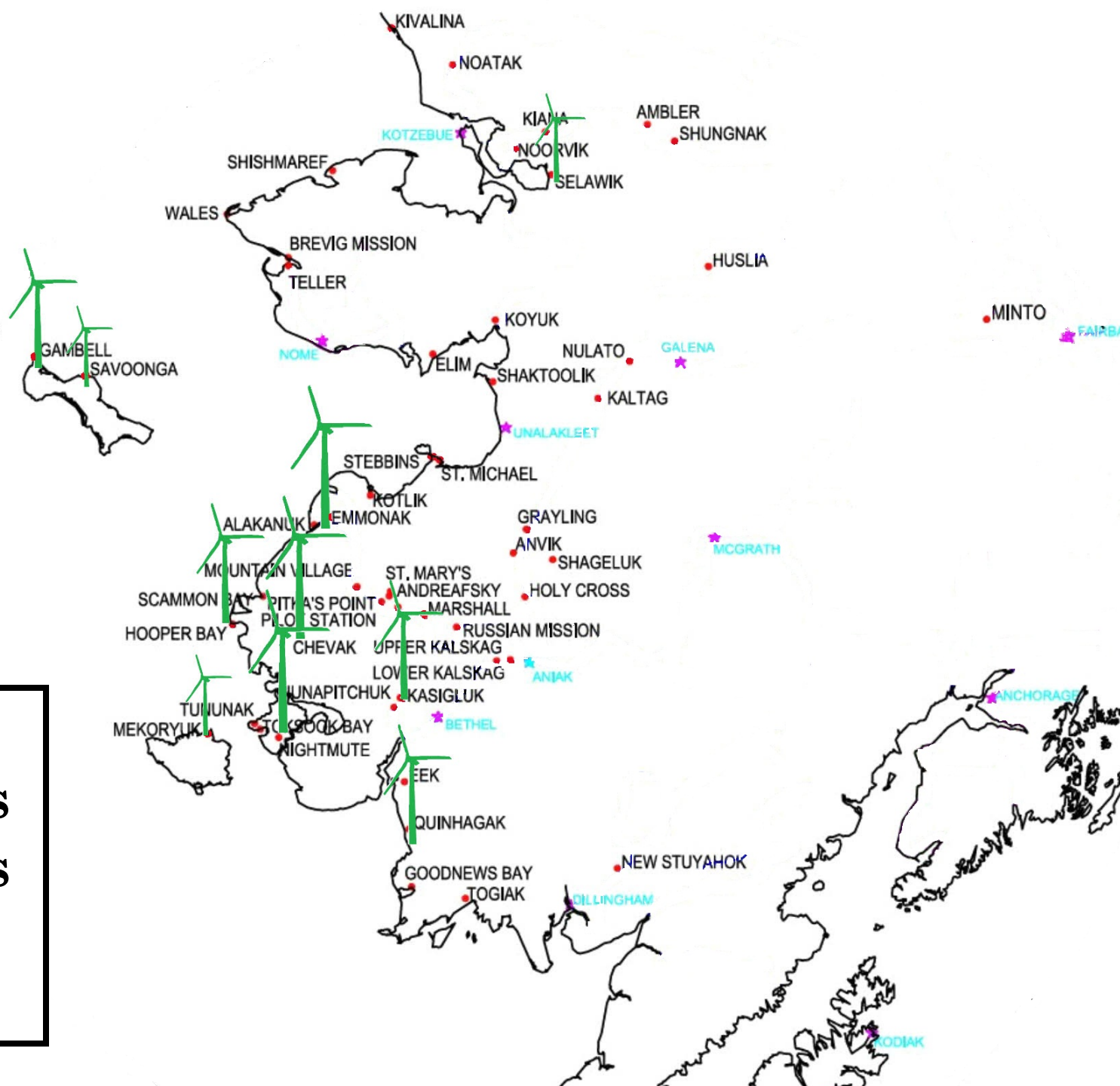
<sup>a</sup> Wind speeds are based on a Weibull k of 1.8. Weibull k values in Alaska vary from 1.4 to 2.0.



U.S. Department of Energy  
National Renewable Energy Laboratory



# Current locations and sizes of wind farms





# CURRENT CHALLENGES TO INFRASTRUCTURE DEVELOPMENT



- Low temperatures and icing
- Limited turbine options for remote villages
- Winter construction is sometimes needed



# Geotechnical Conditions



Soils present unique challenges:

- High variability
- Lack of stability
- Climate change impacts



# CURRENT CHALLENGES TO INFRASTRUCTURE DEVELOPMENT

- Complex logistics
- Complex foundations
- Turbulence



Continued...



# CURRENT CHALLENGES TO INFRASTRUCTURE DEVELOPMENT



- Remote locations
- Poor soils
- Difficult environmental conditions





# Transportation Issues





# Hauling equipment between villages





**And here's the power pole!**







Boardwalks are a challenge



Heavy equipment must be brought in





Roads, water and sewer lines,  
boardwalks and existing overhead power  
and phone lines present hurdles



# CURRENT CHALLENGES TO INFRASTRUCTURE DEVELOPMENT

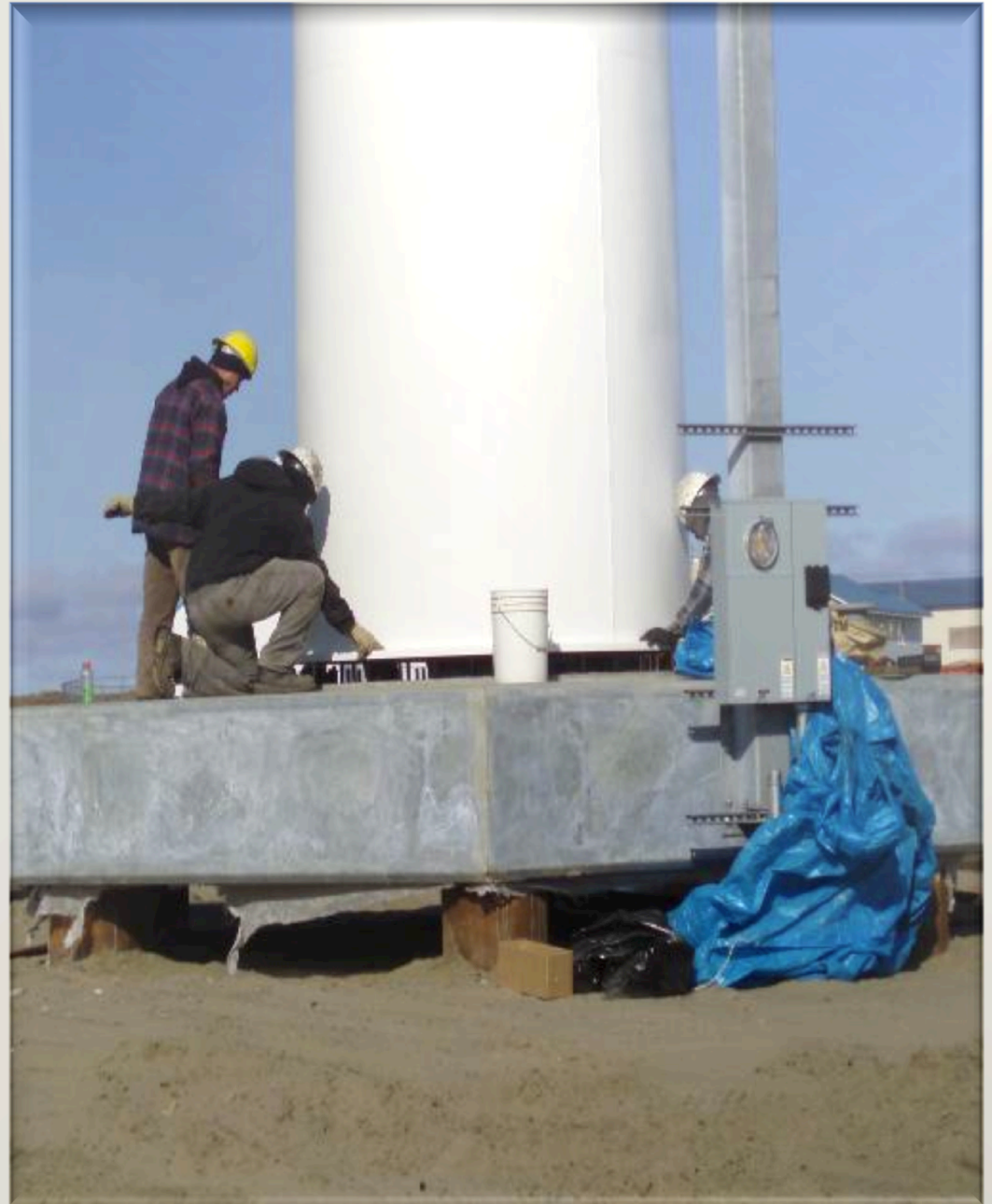
Special equipment may be needed to install the foundation or pilings.



Special equipment, shown here, was required to twist the helical piles into the ground in Kasigluk.

# Foundations in permafrost are a major hurdle

Warming trends are  
affecting the expanse  
and depth of permafrost





# Foundation Design Criteria



Turbines rotate atop 100 (+) foot towers and can cause a detrimental harmonic vibration in the tower and foundation if not designed correctly.



# Foundations in Permafrost

- They must not settle, tilt or be uplifted
- Pile foundations (six to eight piles) may extend  $\frac{1}{3}$  to  $\frac{2}{3}$  the height of the tower into the ground



# Solutions to Challenges:

Dove-tailing  
AVEC projects  
with other local  
projects help  
reduce  
construction  
costs



Solutions Continued...





Consolidating communities makes it feasible to integrate wind.  
Four turbines in Toksook Bay serve Tununak and Nightmute



Toksook Bay, Alaska

Solutions Continued...



# Wind Assessment is critical

- Determining estimated output of a project
- Avoiding misplacement of a project
- Identifying potential problems



# Potential Problems...

- Land ownership and land use in the area
- Geotechnical issues for foundations
- Historical and cultural resource impacts
- Bird issues
- Equipment accessibility
- Proximity to power lines





# Wind Technicians Are Being Trained in AVEC Villages Across Alaska



**AVEC and its  
contractors are  
building local  
capacity by training  
wind technicians who  
live in the villages.**



**These trainees  
have worked in  
the construction  
and operation of  
the new systems**





**TRAINING  
SEVERAL WIND  
TECHNICIANS  
KASIGLUK  
MARCH 2010**



- Stuart Kingeekuk, Savoonga

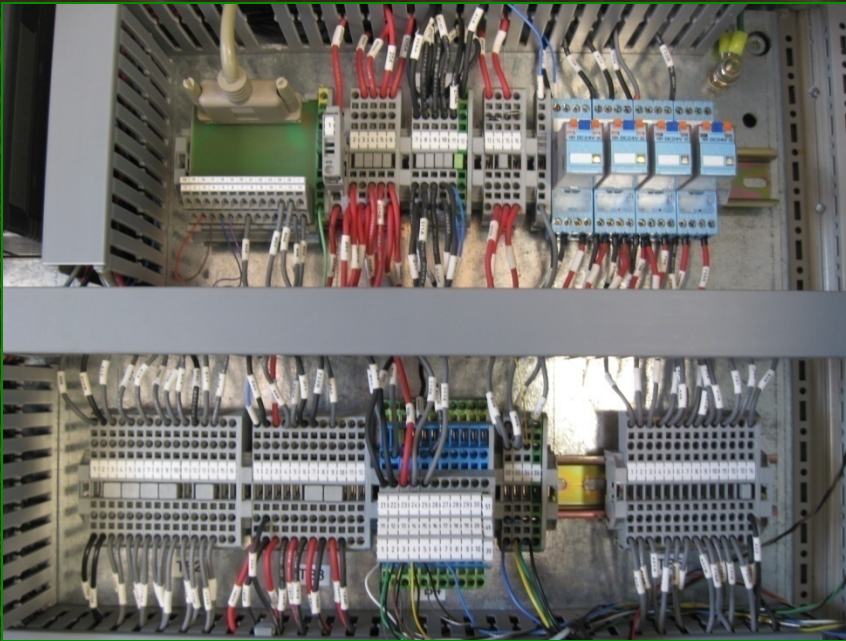


Left to right:

Charles Green, Toksook Bay  
 Elias Friday, Chevak  
 Lawrence Lake, Hooper Bay



# Some of the equipment is complex



# Wind Technicians Lawrence Lake and Julius Bell standing by a nacelle in Hooper Bay





**Wind  
Technician  
Julius Bell  
adjusting the  
rotor assembly  
during the  
installation of  
the NW100 wind  
turbines in  
Hooper Bay,  
Alaska**



# VIEW FROM THE TOP





# THE WORK AND RESULTS ARE REWARDING



# Future Plans

- Meteorological towers are collecting information in several locations
- We are pursuing funding for projects and interties
- We are championing the All Alaska Energy Project



# What Alaskans Spend on Energy

## From 2010 Alaska Power Statistics:

Electricity revenue	\$924 mm
<u>Gas revenue – Southcentral</u>	<u>\$536 mm</u>
Diesel – Fairbanks area	250 mm gallons
Diesel – Kodiak, Copper Valley, SE	68 mm gallons
<u>Diesel – Rest of state</u>	<u>63 mm gallons</u>
TOTAL	381 mm gallons
Diesel value at \$4.00/gallon	\$1,524 mm
Annual cost of electricity/heat	\$2,984 mm
Expenditure in 20 years	\$59.7 billion

# Questions?

*Wales, Alaska*



**Meera Kohler**  
**Alaska Village Electric Cooperative**